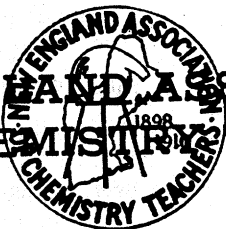


Report of the

NEW ENGLAND ASSOCIATION
OF CHEMISTRY TEACHERS

● NEW WEALTH FROM AGRICULTURE

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THE various utilization branches of the Agriculture Research Service of the U. S. Department of Agriculture do research to find new and expanded uses for farm products. The object is threefold:

(1) To provide more income for the farmer from his crops.

(2) To assist industry to convert agricultural raw materials into new and improved products.

(3) To devise means to make these new products available to the consumer at reasonable prices.

Our object is highly practical in nature, but to reach it we do not confine ourselves exclusively to applied work. Many of our projects are in the field of basic research. We feel that basic research lays the foundation for future specific accomplishments. So let us see some of the new products—new wealth, if you like—which have resulted from our research. Most of my examples will refer to the Eastern Laboratory, but for the sake of completeness I will mention products from each of the other utilization branches.

RUTIN FROM TOBACCO AND BUCKWHEAT

One new product is the drug *rutin*, widely used in medicine today to treat persons with certain blood-vessel disorders. One such disorder doctors call *capillary fault*—that is, a tendency for the walls of the capillary blood vessels to break or to have abnormally high permeability. When capillary fault is combined with high blood pressure the combination is dangerous—something like a weak garden hose connected to a source of high water pressure; the blood vessel may rupture. Rupture within the brain means a stroke, rupture in the eye a retinal hemorrhage.

Medical studies show that rutin, taken orally, will correct a large proportion of capillary fault—about 94 per cent of all cases. When the capillary condition is returned to normal there is less tendency to apoplexy and retinal hemorrhage.

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The story starts in 1942, when Dr. James F. Couch isolated rutin from flue-cured tobacco. Mindful of the emphasis of new uses, he immediately began wondering what use rutin could have.

Now rutin was not new—it had been discovered 100 years earlier in garden rue, which gave it its name. It had even been found in tobacco before.

But what use was it? That was when Dr. Couch came up with his brilliant hunch—rutin ought to have vitamin P activity. Vitamin P was the name given by a Hungarian chemist to an elusive component of citrus extracts.

It had been observed that citrus extract sometimes helped persons with capillary fault, but the active principle was never isolated. However, enough chemical information was accumulated to suggest to Dr. Couch that rutin might have vitamin P activity—or might even be the long-sought vitamin P itself. Tests were made by two medical researchers then at the University of Pennsylvania Medical School, and rutin worked!

The medical profession took up and applied this advance in medicine, and doctors all over the world were writing in to ask for samples for their desperately ill patients. Our little research group worked round the clock, extracting rutin, until industry took over the job.

It quickly became evident that flue-cured tobacco would never do as a source. It was far too expensive. So the hunt went on for a better source.

The best domestic source yet found is the green buckwheat plant. When we found that out we envisioned farmers growing buckwheat for rutin—perhaps 50,000 acres planted to buckwheat. Alas, it was not to be! Someone found out that rutin could be extracted more cheaply from the flower buds of an oriental tree, the *Sophora japonica*, and much was made from the buds.

Later an embargo was placed on the importing of these flower buds, and for a fleeting instant we thought buckwheat would re-enter the picture. But instead, it was found that the leaves of a variety of eucalyptus

tree that grows in Australia made a cheap source and much rutin is now made from eucalyptus leaves.

We are not, however, convinced that this is the final answer. We think that buckwheat can compete. All it will take, we feel, is careful processing of the buckwheat.

DEXTRAN: A BLOOD PLASMA SUBSTITUTE

Now I turn to another development in the field of medicine. This is a development of our sister laboratory in Peoria. It is the blood-plasma volume expander *dextran*.

The Northern Laboratory has a remarkable collection of microorganisms. This culture collection—which is sometimes called a “microbe zoo” by the science writers—has been the foundation of many advances in industrial fermentation.

In extreme national emergency, such as atomic war, it would be practically impossible to make enough blood plasma to serve those suffering from shock, burns, or other casualties.

Nonetheless, casualties may be enormous, so some alternative measures must be worked out, and as soon as possible. The best answer at present is to develop a stable blood-plasma substitute that can be stockpiled. And that is dextran.

Natural dextran is a polysaccharide, just as starch, glycerin, and cellulose are polysaccharides. It differs from these, however, in the linkages which hold the glucose units together. In dextran the linkages are called the alpha-1,6 type; in starch they are the alpha-1,4 type.

Dextran is made by a number of bacteria of the family *Lactobacteriaceae*, grown in cultures containing sucrose. Actually, the organisms make an enzyme called *dextranucrase*, and it is the enzyme that does the job. The enzyme works on the glucose half of the sucrose molecule.

At present four companies are producing dextran at a yearly rate of over 2 ½ million pints of a six per cent solution, and they are all using the microorganism isolated by our Northern-Branch scientists. This bacterium originally came from a bottle of contaminated—“ropy”—root beer.

IMPROVEMENTS IN COTTON

Our Southern Branch in New Orleans has developed fibers and fabrics from cotton that will not rot or mildew, are highly flame-resistant, hold up under high temperatures for long periods of time, and last more than twice as long in outdoor uses. They have even made cotton fibers that dissolve in water, for special uses. In mechanical processing research, equipment has been developed for more efficient processing of mechanically harvested cotton, which contains large quantities of foreign matter.

Research to improve the competitive position of cotton is highly important to the more than 20 million people who depend on the industry for all or part of

their livelihood. In 1951 farmers received nearly three billion dollars for their lint cotton.

CONCENTRATED FRUIT JUICES

If you like orange juice you must have tasted the juice made by mixing three cans of water with one can of frozen orange-juice concentrate. That is a joint development of our Southern Branch with the Florida Citrus Commission.

We have, in Philadelphia, developed superconcentrated fruit juices such as apple juice and grape juice. We say “superconcentrated” because to one can of our juice you add six cans of water, instead of the conventional three cans. So, from a four-ounce can you get more drinking juice than from a six-ounce can of the conventional frozen-juice concentrates.

The product has excellent flavor. The trick is to take out and hold the flavor of the fresh juice right at the start. Our Eastern-Laboratory engineers found how to take out the volatile flavor from apple juice, for example, and concentrate it. This flavor concentrate we call “essence.”

The scale of operations goes something like this. We take a ton of apples and press out the juice, and get about 160 gallons. Now we run the 160 gallons of juice through our “essence” equipment and get a gallon of flavor. Thus, all the volatile flavor in a ton of apples is now present in one gallon—and that gallon, by the way, is 99 per cent water.

Now we take the 159 gallons of stripped juice, and evaporate away about 137 gallons of water. There is now left 22 gallons of the concentrated nonvolatile components of our apple juice. To it we add our gallon of essence, and we have essentially everything that was in the starting juice, except water. You can add the water at the kitchen sink.

FRUIT-JUICE POWDERS

The latest development in the fruit-juice line is powdered fruit juice. Our Western Branch, at Albany, California, has succeeded in making 100 per cent orange-juice powder which can be kept without any refrigeration. The starting material is concentrated orange juice, which is dried under vacuum. As it dries the mixture puffs up. The puffy cake is then crushed to suitable size and the product packed. The powder passes the army test, stability under six month's storage at 100°F., with flying colors. The trick is to keep the powder dry, and to do this an envelope of desiccant is put in every package. The orange flavor is added prior to packaging.

A factory is now under construction in Florida to make the orange powder, which needs only water to make a very good orange juice. It compares favorably with the frozen, concentrated orange juice.

In Philadelphia we have made apple-juice powder and grape-juice powder, which keep well even after six months at 100°F. We were afraid that drying the superconcentrate under vacuum would pull out all the

volatile flavor, but our engineers solved that problem when they found that sugar added to the superconcentrate "locked in" the flavor. Here also an in-package desiccant is needed to keep the powder dry and stable.

NEW PRODUCTS FROM MAPLE SIRUP

We have found that if you heat good quality maple sirup under controlled conditions, you can enhance the maple flavor and the color many-fold. To this high-flavored maple sirup can be added ordinary cane-sugar sirup, say three parts of cane sirup to one part of maple sirup. The resulting blend can scarcely be told from pure maple.

High-flavored maple sirup is produced now in carload quantities and used in several ways; new markets are opening for maple and the future looks brighter for maple producers.

USES FOR ANIMAL FATS

A new potential market is in plastics. Our chemists have attacked the plastic market in two ways. One is by converting fats and oils to stabilizers-plasticizers. All flexible plastics, as we know them, get that way by the incorporation of plasticizers, which act as softening agents.

Now a common plastic is polyvinyl chloride. It is a good plastic, but is affected adversely by sunlight and

heat. Animal fats and vegetable oils are treated with hydrogen peroxide to make epoxidized oils. These are good plasticizers, and also protect the base plastic against heat and light. They are now in commercial production and are used in garden hose, floor tiles, raincoats, and the like.

Good as our epoxidized oils are, they are nevertheless "external" plasticizers. And all external plasticizers have one flaw to a greater or less extent, and that is a tendency to diffuse to the surface and then evaporate or wash away.

That leads us to the second attack on plastics; this is to use "built-in" plasticizers.

You know that fats contain stearic acid. By adding acetylene to stearic acid you can make vinyl stearate, which will copolymerize with vinyl chloride. The stearic acid part acts as a lubricant, or softener. But since it is part of the copolymer it is firmly bound in. It is a "built-in" plasticizer and hence is free of the tendency to diffuse out and get lost.

Another enormous market for animal fats is as a component of animal feeds. We worked with the American Meat Institute Foundation and found experimentally that dogs and chickens thrived when fed diets containing added animal fat. That was the start of the addition of animal fats to many other animal feeds. Now enormous amounts of fats are used in feeds—perhaps a quarter of a million pounds yearly.